

(19)

Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 0 988 882 A3**

(12)

## EUROPEAN PATENT APPLICATION

(88) Date of publication A3:  
30.08.2000 Bulletin 2000/35

(51) Int Cl.7: **B01D 53/047, B01D 53/053**

(43) Date of publication A2:  
29.03.2000 Bulletin 2000/13

(21) Application number: **99305730.6**

(22) Date of filing: **20.07.1999**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventor: **Doong, Shain-Jer**  
**Millington, New Jersey 07946 (US)**

(74) Representative: **Wickham, Michael et al**  
**c/o Patent and Trademark Department**  
**The BOC Group plc**  
**Chertsey Road**  
**Windlesham Surrey GU20 6HJ (GB)**

(30) Priority: **24.07.1998 US 122559**

(71) Applicant: **THE BOC GROUP, INC.**  
**Murray Hill, New Providence,**  
**New Jersey 07974-2082 (US)**

### (54) Pressure swing adsorption process and apparatus

(57) A process and system for separating the components of a gas mixture by PSA in a four-vessel adsorption system operated as two pairs of adsorption vessels. The vessels of each pair are operated 180° out of phase, such that one vessel of a pair is in the adsorption mode while the other vessel of the pair is undergoing adsorbent regeneration. The apparatus includes the two pairs of adsorption vessels, typically an intermediate gas storage reservoir which is used to temporarily

store gas removed from the non-adsorbed gas outlet end of the adsorption vessels for use in various steps of the process, one gas blower and a pair of vacuum pumps. The adsorption cycle is such that the pairs of adsorption vessels are operated out of phase relative to each other and the blower and both vacuum pumps can be in continuous operation throughout the process. The process and system are particularly well adapted to the separation of nitrogen from oxygen by vacuum swing adsorption.

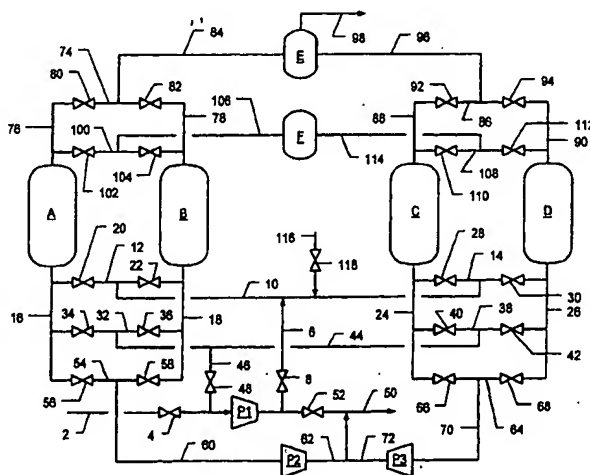


FIG. 1

EP 0 988 882 A3



European Patent  
Office

## EUROPEAN SEARCH REPORT

Application Number  
EP 99 30 5730

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D, A	US 5 656 068 A (SMOLAREK ET AL) 12 August 1997 (1997-08-12) * column 4, line 24 - column 11, line 26 * ---	1-3, 8-10, 12	B01D53/047 B01D53/053
A	EP 0 791 388 A (AIR PRODUCTS AND CHEMICALS, INC ) 27 August 1997 (1997-08-27) * page 4, line 12 - page 8, line 58 * ---	1-3, 6, 8-10, 12	
P, A	EP 0 873 776 A (THE BOC GROUP, INC.) 28 October 1998 (1998-10-28) * page 2, line 43 - page 7, line 45 * ---	1, 2, 6, 8, 10-12	
A	DE 196 27 422 A (BAYER AG) 15 January 1998 (1998-01-15) * page 2, line 56 - page 4, line 66 * -----	1, 10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B01D
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>7 July 2000</b>	Examiner <b>Doolan, G</b>
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 30 5730

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-07-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5656068 A	12-08-1997	BR 9701125 A	25-08-1998
		CA 2198789 A	29-08-1997
		EP 0808651 A	26-11-1997
EP 791388 A	27-08-1997	US 5656067 A	12-08-1997
		CA 2197738 A	24-08-1997
EP 873776 A	28-10-1998	US 5846294 A	08-12-1998
		AU 6353898 A	29-10-1998
		CA 2232181 A	23-10-1998
		CN 1210747 A	17-03-1999
		JP 10314531 A	02-12-1998
		PL 325933 A	26-10-1998
		ZA 9802295 A	23-09-1998
DE 19627422 A	15-01-1998	BR 9710225 A	10-08-1999
		CA 2259660 A	15-01-1998
		CZ 9900040 A	11-08-1999
		WO 9801215 A	15-01-1998
		EP 0910457 A	28-04-1999
		PL 331017 A	21-06-1999

EPO FORM P4459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82